CC – UNIT 3 PYQ'S

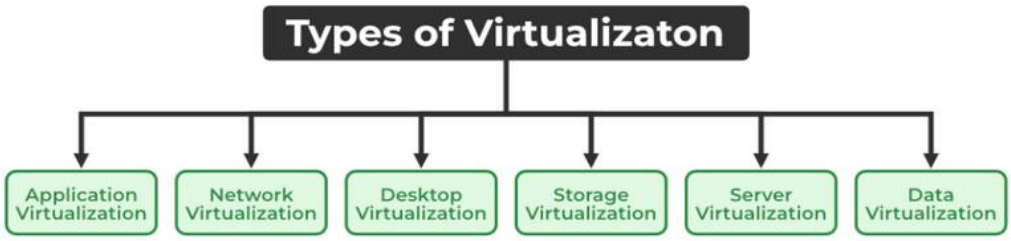
- **MAY / JUN 2022**

Q1

a) Define Virtualization? Explain different types of Virtualizations? [8]

Virtualization is the process of creating a virtual representation of hardware such as server, storage, network or other physical machines.

Types of Virtualization :



1. **Application Virtualization**: Application virtualization enables remote access by which users can directly interact with deployed applications without installing them on their local machine. Your personal data and the applications settings are stored on the server, but you can still run it locally via the internet.

   Example: Microsoft Azure lets people use their applications without putting them on their own computers.

2. **Network Virtualization**: This allows multiple virtual networks to run on the same physical network, each operating independently. You can quickly set up virtual switches, routers, firewalls, and VPNs, making network management more flexible and efficient.

   Example: Google Cloud is an example of Network Virtualization. Companies create their own networks using software instead of physical devices with the help of Google Cloud.

3. Desktop Virtualization: Desktop virtualization is a process in which you can create different virtual desktops that users can use from any device like laptop, tablet. It's great for users who need flexibility, as it simplifies software updates and provides portability.

Example: GeeksforGeeks is a Edtech company which uses services like Amazon WorkSpaces or Google Cloud (GCP) Virtual Desktops to give its team members access to the same coding setup with all the tools they required for the easy access of this team work.

4. Storage Virtualization: This combines storage from different servers into a single system, making it easier to manage. It ensures smooth performance and efficient operations even when the underlying hardware changes or fails.

Example: Amazon S3 is an example of storage virtualization because in S3 we can easily store any amount of data from anywhere.

5. Server Virtualization: This splits a physical server into multiple virtual servers, each functioning independently. It helps improve performance, cut costs and makes tasks like server migration and energy management easier.

Example: A startup company has a powerful physical server. This company can use server virtualization software like VMware vSphere, Microsoft Hyper-V or KVM to create more virtual machines(VMs) on that one server.

6. Data Virtualization: This brings data from different sources together in one place without needing to know where or how it's stored. It creates a unified view of the data, which can be accessed remotely via cloud services.

Example: Companies like Oracle and IBM offer solutions for this.

b) Discuss Virtualization in Grid and Virtualization in Cloud? [9]

Virtualization in Grid Computing

- Virtualization in Grid computing focuses on secure resource sharing across geographically distributed systems. It uses real physical resources located at multiple sites, connected together to perform large-scale computations. The architecture is typically loosely coupled, and systems are coordinated using grid middleware like gLite or Globus Toolkit.
- Managing resources in grid virtualization is often complex, as it involves distributed physical machines. Resource allocation is generally static, where specific resources are reserved in advance for particular tasks. It lacks automation and flexibility compared to cloud environments.
- The cost model in Grid computing is usually free or research-funded, with limited commercial deployment. Grid systems also face challenges with fault tolerance, as failure handling is manual and less efficient.
- Users typically interact with Grid platforms using command-line tools or specialized job submission software. Examples of virtualization in grid computing include SETI@home and the CERN Grid used in high-energy physics research.

Virtualization in Cloud Computing

- Virtualization in Cloud computing is the core technology that enables the delivery of on-demand, scalable services over the internet. It uses virtualized resources such as virtual CPUs, storage, and networks, rather than relying on direct physical hardware access.
- Cloud architecture is tightly integrated, managed through centralized platforms with high levels of automation. Resource management is easier and supports dynamic allocation, meaning resources can be scaled up or down automatically based on user demand.
- The cloud uses a pay-as-you-go or subscription-based cost model, which is ideal for commercial use. It offers high flexibility, automatic provisioning, and multi-tenancy, where multiple users share the same infrastructure securely.
- Cloud platforms are built with built-in fault tolerance and auto-recovery mechanisms, ensuring high availability. They provide user-friendly interfaces, such as web portals and APIs, making access easy even for non-technical users.
- Examples of cloud virtualization platforms include Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform, all of which use hypervisors to manage virtual machines and services.

NOTE :

Added same point in question differentiation between virtualization grid computing and virtualization cloud computing.

Q2)

a) Differentiate between full and para virtualization? [8]

S.No.	Full Virtualization	Paravirtualization
1.	**In Full virtualization, virtual machines permit the execution of the instructions with the running of unmodified OS in an entirely isolated way.**	**In paravirtualization, a virtual machine does not implement full isolation of OS but rather provides a different API which is utilized when OS is subjected to alteration.**
2.	**Full Virtualization is less secure.**	**While the Paravirtualization is more secure than the Full Virtualization.**
3.	**Full Virtualization uses binary translation and a direct**	**While Paravirtualization uses hypercalls at compile time for**

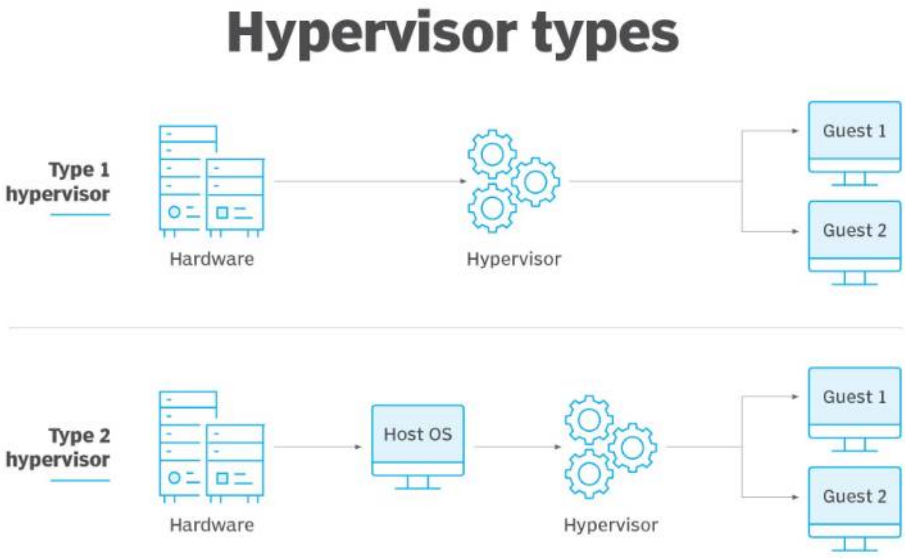
S.No.	Full Virtualization	Paravirtualization
	approach as a technique for operations.	operations.
4.	Full Virtualization is slow than paravirtualization in operation.	Paravirtualization is faster in operation as compared to full virtualization.
5.	Full Virtualization is more portable and compatible.	Paravirtualization is less portable and compatible.
6.	Examples of full virtualization are Microsoft and Parallels systems.	Examples of paravirtualization are Microsoft Hyper-V, Citrix Xen, etc.
7.	It supports all guest operating systems without modification.	The guest operating system has to be modified and only a few operating systems support it.
8.	The guest operating system will issue hardware calls.	Using the drivers, the guest operating system will directly communicate with the hypervisor.
9.	It is less streamlined compared to para-virtualization.	It is more streamlined.
10.	It provides the best isolation.	It provides less isolation compared to full virtualization

b) Explain the functionality of hypervisor? What is type l and type 2 hypervisor? [9]

A **hypervisor**, also called a **Virtual Machine Monitor (VMM)**, is a software used in virtualization to run multiple virtual machines (VMs) on a single physical machine.

It manages hardware resources such as CPU, memory, and storage, and allocates them to the VMs.

Hypervisors ensure proper isolation between virtual machines and enable better resource utilization in cloud computing.



There are **two main types of hypervisors**:

1. Type-1 Hypervisor (Bare-Metal Hypervisor):

This type runs **directly on the physical hardware** without any operating system in between. It is also known as a native hypervisor and is commonly used in data centers and cloud infrastructure due to its high performance and efficiency.

Examples include **VMware ESXi, Microsoft Hyper-V, and Citrix XenServer**.

Advantages:

It provides **better performance and security** since it has direct access to hardware.

Disadvantages:

It usually requires a **dedicated system** and may be more complex to set up.

2. Type-2 Hypervisor (Hosted Hypervisor):

This type runs on top of a host operating system as an application. It is mainly used for personal use, testing, or development purposes.
Examples include VirtualBox, VMware Workstation, and Parallels Desktop.

Advantages*:*
It is easy to install and manage, and allows running multiple OSes on a regular PC.
Disadvantages*:*
Since it relies on the host OS, it may have lower performance and potential security risks compared to Type-1.

- **NOV / DEC 2022**

Q1)

a) Describe CPU, Network and Storage Virtualization? [9]

1. CPU Virtualization

CPU virtualization allows multiple virtual machines (VMs) to run on a single physical CPU by creating virtual CPUs (vCPUs) through a hypervisor. Each VM behaves like it has its own CPU.

How it works:
The hypervisor maps physical CPU resources to virtual CPUs (vCPUs). It schedules and allocates processor time to each VM, allowing multiple OSes to share CPU resources efficiently without interfering with each other.

Example: VMware Workstation or Oracle VirtualBox allows running multiple OS environments (like Linux and Windows) on the same system using vCPUs.

---

2. Network Virtualization

This allows multiple virtual networks to run on the same physical network, each operating independently. You can quickly set up virtual switches, routers, firewalls, and VPNs, making network management more flexible and efficient.

How it works:
Network virtualization uses software-defined networking (SDN) to abstract physical network resources. Virtual switches and routers route traffic between VMs as if they were on separate physical networks.

Example: Google Cloud is an example of Network Virtualization. Companies create their own networks using software instead of physical devices with the help of Google Cloud.

---

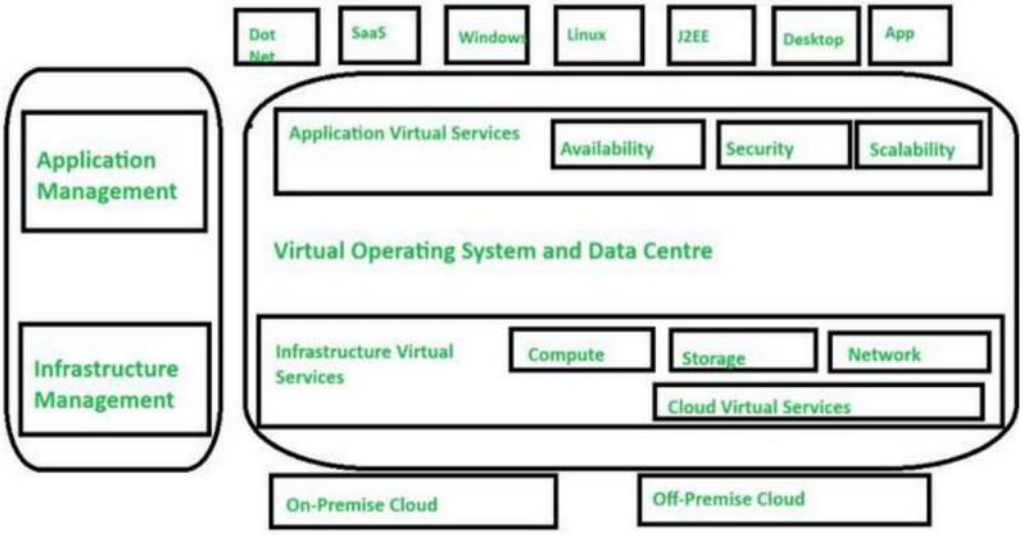
3. Storage Virtualization

This combines storage from different servers into a single system, making it easier to manage. It ensures smooth performance and efficient operations even when the underlying hardware changes or fails.

How it works:
Storage virtualization aggregates data from different storage devices into a centralized pool. The hypervisor or storage manager allocates virtual storage to VMs as required, hiding the underlying complexity of the physical storage infrastructure.

Example: Amazon S3 is an example of storage virtualization because in S3 we can easily store any amount of data from anywhere. Suppose a MNC has lots of files and data of the company to store.

b) Draw and Explain the Virtualization Architecture in detail? [8]



1. Application Management:

- Manages and supports various applications like .NET, SaaS, J2EE, Windows, Linux, etc.
- Offers flexibility to run apps independently of the underlying hardware.

2. Application Virtual Services:

- **Provides services like:**
  - Availability: Ensures continuous access.
  - Security: Protects data and applications.
  - Scalability: Supports resource expansion.

3. Infrastructure Management:

- Takes care of managing compute, network, and storage resources.
- Helps in automating and optimizing infrastructure resources.

4. Infrastructure Virtual Services:

- Compute: Provides virtual CPUs and processing power.
- Storage: Combines multiple storage devices into virtual pools.
- Network: Allows creation of virtual routers, switches, and secure connections.
- Cloud Virtual Services: Delivers infrastructure on-demand from cloud**.**

5. Virtual Operating System and Data Centre:

- Central part of the architecture.
- Integrates both application and infrastructure services.
- Acts as a control hub for managing all virtual services.

6. On-Premise & Off-Premise Cloud:

- Services can be accessed from local data centers (on-premise) or remote clouds (off-premise).
- Offers flexibility in deployment.

7. Hypervisor Role:

- Separates the OS from hardware.
- Allows multiple VMs to run on a single host machine.
- Ensures isolation and efficient resource sharing.

Q2 a) already done i.e repeated

b) Differentiate between Virtualization in Grid and Virtualization in Cloud [8]

Point	**Virtualization in Grid**	**Virtualization in Cloud**
1. Purpose	**Focuses on resource sharing across geographically distributed systems.**	**Focuses on providing scalable, on-demand services via the internet.**
2. Resource Type	**Uses real physical resources from multiple locations.**	**Uses virtualized resources (CPU, storage, network) over the cloud.**

3. Architecture	**Loosely coupled systems connected via grid middleware.**	**Tightly integrated using virtualization and cloud platforms.**
4. Management	**Complex to manage due to distributed nature.**	**Easier to manage using central cloud platforms.**
5. Resource Allocation	**Static allocation; users reserve specific resources.**	**Dynamic allocation based on demand and usage.**
6. Cost Model	**Often free or academic; less focus on commercial usage.**	**Pay-as-you-go model; commercial providers charge based on usage.**
7. Flexibility	**Less flexible; limited automation.**	**Highly flexible with automatic provisioning and scalability.**
8. Examples	**SETI@home, CERN Grid**	**AWS, Microsoft Azure, Google Cloud**
9. Fault Tolerance	**Fault tolerance is complex and managed manually.**	**Built-in fault tolerance and auto-recovery features.**
10. Interface	**Uses command-line or research-specific tools.**	**Accessible via web portals or APIs.**
11. Cost	**Often free or research-funded, not pay-based.**	**Pay-per-use or subscription-based.**

➢ **MAY / JUN 2023 UNIT – 3 PYQ**

Q1 a) , b) already done i.e repeated !!

Q2

a) Describe virtual clustering in cloud computing? [9]

Definition:

Virtual clustering in cloud computing refers to the grouping of virtual machines (VMs) or virtualized resources across multiple physical systems to form a virtual cluster. These virtual clusters function similarly to physical clusters, allowing distributed computing, scalability, and high availability.

Explanation:

- A cluster is a group of servers or machines that work together as a single system.
- In virtual clustering, the nodes of the cluster are virtual machines instead of physical machines.
- These VMs can be hosted on multiple physical servers but appear as a single unit to the user or application.

Key Features:

1. **Dynamic Resource Allocation**: Resources like CPU, memory, and storage can be scaled as needed across virtual nodes.
2. **Fault Tolerance:** If one VM/node fails, the workload can be shifted to another node in the cluster.
3. **Load Balancing**: Tasks are distributed across virtual machines to avoid overloading any single VM.
4. **Improved Utilization**: Physical hardware is used more efficiently by running multiple virtual nodes.
5. **Isolation**: Each VM in the cluster can run a different OS or application environment.
6. **Cost Efficiency:** Reduces the need for dedicated physical hardware by using virtual infrastructure.

Use in Cloud Computing:

- Cloud platforms like AWS (EC2 instances) and Microsoft Azure use virtual clustering to provide scalable and high-availability services.
- Helps in multi-tier application deployment, big data processing, and parallel computing in cloud environments.
- Enables elastic scaling, where VMs are added or removed from the cluster based on demand.

Q2

b) Explain the importance of hypervisor in cloud computing? Compare Type 1 and Type 2 hypervisor? [8]

A **hypervisor** is a software layer that enables **virtualization** by allowing multiple **virtual machines (VMs)** to run on a single physical host.

Importance of Hypervisor in Cloud Computing:

1. **Resource Sharing**: Allows multiple VMs to share CPU, memory, and storage, optimizing hardware usage.
2. **Isolation**: Ensures each VM operates independently, enhancing **security** and **fault tolerance**.
3. **Scalability**: Enables easy creation, scaling, and management of VMs as per demand.

4. **Flexibility**: Supports running different OSes on the same hardware, ideal for cloud environments.
5. **Cost Efficiency**: Reduces need for physical machines, cutting infrastructure and maintenance costs.

Point	Type-1 Hypervisor	Type-2 Hypervisor
Also Known As	Bare-Metal or Native Hypervisor	Hosted Hypervisor
Runs On	Directly on physical hardware	On top of a host operating system
Performance	High performance (direct hardware access)	Lower performance (depends on host OS)
Usage	Used in data centers and enterprise cloud setups	Used for personal, testing, or development purposes
Examples	VMware ESXi, Microsoft Hyper-V, Citrix XenServer	VirtualBox, VMware Workstation, Parallels Desktop
Security	More secure (less layers = fewer attack points)	Less secure (host OS can be attacked)
Setup Requirement	Needs dedicated hardware setup	Can run on existing OS without extra setup

---

➢ **NOV / DEC 2023 UNIT – 3 PYQ**

Q1) a) Expiain virtual clustering in cloud computing? [9]

→ already done !

b) Describe the importance of hypervisor in cloud computing? Differentiate Type I and Type 2 hypervisor?

→ Already done !

Q2)

a) Compare grid computing and cloud computing?

Point	Grid Computing	Cloud Computing

1. Definition	**Combines resources from multiple systems to work on a single large task.**	**Delivers computing services (e.g., servers, storage, apps) over the internet.**
2. Purpose	**Mainly used for scientific or academic tasks that need high processing power.**	**Used for commercial, enterprise, and user-level services on-demand.**
3. Architecture	**Distributed and loosely coupled nodes.**	**Centralized or hybrid, managed by cloud providers.**
4. Resource Type	**Uses real physical hardware from multiple locations.**	**Uses virtualized resources (CPU, storage, network).**
5. Virtualization	**Limited or no virtualization.**	**Heavy use of virtualization (VMs, containers).**
6. Resource Allocation	**Static resource allocation, manual setup.**	**Dynamic, automated provisioning and scaling.**
7. Accessibility	**Limited, often internal to institutions.**	**Global accessibility via internet or APIs.**
8. Interface	**Mostly command-line or job submission tools.**	**Web-based GUI, APIs, CLI — user-friendly.**
9. Fault Tolerance	**Fault tolerance is manual and complex.**	**Built-in auto-recovery and failover mechanisms.**
10. Cost Model	**Usually free or funded by research projects.**	**Pay-as-you-go or subscription-based billing.**
11. Scalability	**Limited scalability, depending on participating systems.**	**Highly scalable, elastic according to demand.**
12. Examples	**SETI@Home, CERN Grid**	**AWS, Microsoft Azure, Google Cloud**

b) Define virtualizations? Describe the advantages and disadvantages of Virtualization? [8]

→ already done !

- **MAY / JUN 2024 UNIT – 3 PYQ**

Q1 a) , b) , c)

-----> already covered !

Q2)

a) Explain Virtualization Application and Pitfalls of Virtualization?

1. Virtualization Applications in Cloud Computing:

Virtualization has a wide range of applications in cloud computing. It helps in maximizing hardware usage, reducing costs, and improving scalability and management.

Key Applications:

1. **Server Consolidation:**
   Multiple virtual servers run on a single physical machine, improving resource utilization.
2. **Test and Development Environments:**
   Developers can create isolated VMs for testing new applications without affecting the main system.
3. **Disaster Recovery and Backup:**
   Virtual machines can be easily backed up, cloned, and restored, enhancing disaster recovery strategies.
4. **Desktop Virtualization:**
   Allows users to access their desktop environment remotely via thin clients.
5. **Cloud Service Models (IaaS, PaaS, SaaS):**
   Virtualization is the foundation of cloud service models, enabling dynamic allocation of infrastructure and services.
6. **Load Balancing and High Availability:**
   Workloads can be distributed across multiple VMs, and services can continue running even if one VM fails.

2. Pitfalls of Virtualization:

Despite its many benefits, virtualization also has certain drawbacks or limitations.

Key Pitfalls:

1. **Performance Overhead:**
   VMs may not match the performance of physical machines due to shared resources and virtualization layers.
2. **Security Risks:**
   A compromised hypervisor can lead to access of all hosted VMs, making it a high-value attack target.
3. **Complex Management:**
   Managing large virtual environments requires specialized tools and trained professionals.
4. **License and Compliance Issues:**
   Licensing for software in virtual environments can be complex and sometimes costlier.

5. **Resource Contention:**
   If not properly managed, multiple VMs can compete for the same physical resources, leading to performance degradation.
6. **Troubleshooting Difficulties:**
   Issues in a virtual environment can be harder to isolate and fix due to abstraction layers.

b) Explain Virtual clustering in detail?

----> already done !

c) Explain virtual machine migration technique in detail?

Virtual Machine (VM) migration refers to moving a running VM from one physical host to another with minimal downtime, ensuring the VM's state and functionality are preserved. It is crucial for load balancing, maintenance, and fault tolerance in cloud and virtualized environments.

There are two primary types of VM migration:

LIVE MIGRATION :

Live Migration allows a virtual machine to be moved from one physical host to another without shutting it down.

The VM continues running during the transfer, with memory, CPU state, and storage being synchronized in real-time.

Once synchronization is complete, the VM is briefly paused to finalize the migration and resumes on the new host with minimal downtime.

Advantages:

- No downtime, ensuring continuous service availability.
- Ideal for load balancing, maintenance, and fault tolerance.

COLD MIGRATION :

Cold Migration, on the other hand, involves powering off the VM before transferring its virtual disk files and configurations to the target host.

After the transfer, the VM is powered back on at the new host, but this process incurs downtime, making it suitable for scenarios where uninterrupted service is not critical.

Advantages:

- Simpler to implement.

- Suitable when downtime is acceptable

VM migration is a critical technique used to ensure resource optimization, system availability, and seamless maintenance in virtualized environments.

➢ **NOV / DEC 2024 UNIT- 3 PYQ**

Q1)

a) Define Virtualization? Describe different types of Virtualizations? [9] ----> already done !

b) Differentiate between Virtualization in Grid and Virtualization in Cloud?[8] ---→ already done !

Q2)

a) Describe CPU, Network and Storage Virtualization? [9] ----> already done !

b) Draw and Explain the Virtualization Architecture in detail? [8] ----> already done !